

# CARYOPHYLLACEAE IN NORTH AMERICA: CHANGE OVER THE LAST 110 YEARS

Richard K. Rabeler

University of Michigan Herbarium  
3600 Varsity Drive  
Ann Arbor, Michigan 48108-2228, U.S.A.  
rabeler@umich.edu

Ronald L. Hartman

Rocky Mountain Herbarium  
Department of Botany  
University of Wyoming  
Laramie, Wyoming 82071-3165, U.S.A.  
rhartman@uwyo.edu

## ABSTRACT

We compare the treatment of the Caryophyllaceae in *Flora of North America* (Rabeler & Hartman 2005), with that in the *Synoptical Flora of North America* (Robinson 1897), summarizing additions in native and introduced species by subfamily, genus, and location of discovery or where first noted.

## RESUMEN

Comparamos el tratamiento de las Caryophyllaceae en la *Flora of North America* (Rabeler & Hartman 2005), con el de la *Synoptical Flora of North America* (Robinson 1897), resumiendo adiciones en las especies autóctonas e introducidas por subfamilia, género, y localización del descubrimiento o donde fue encontrada por primera vez.

Publication of the Caryophyllaceae in *Flora of North America* [FNA] (Rabeler & Hartman 2005) presented the opportunity to compare those results with previous efforts. Our treatment is the first to include all taxa accepted for North America north of Mexico since that by B.L. Robinson (1897) in *Synoptical Flora of North America*.

The family treatment for FNA was the combined effort of ten authors, two of whom also served as editors. Four subfamilies were recognized in which 286 species and 54 infraspecific taxa belonging to 37 genera were treated in 212 pages of illustrated text.

By contrast, the Caryophyllaceae in *Synoptical Flora of North America* was published solely by B.L. Robinson. It first appeared as two papers (Robinson 1893, 1894) “preliminary to [the] treatment” in the *Flora* and then in the second fascicle of the *Synoptical Flora* (Robinson 1897). Three subfamilies containing 167 species and 53 infraspecific taxa belonging to 19 genera were treated in 48 pages sans illustrations. The Illecebraceae (Paronychioideae) were placed far from the Caryophyllaceae, following G. Bentham and J.D. Hooker’s (1862–1883) classification, and apparently were never published. Based on members of this subfamily that were known by 1890, we estimate that 7 genera, 24 species, and 1 infraspecific taxon would have been included in the Paronychioideae (and the tallies for the Caryophyllaceae), expanding the treatment by several pages (Table 1).

The Caryophyllaceae worldwide contain about 3000 species in 83 (*Silene* s.l.) or 89 (*Silene* s.s.) genera (Rabeler & Hartman 2005). We followed a four-subfamily classification which emphasizes morphological features but is yet to be adequately tested by molecular analyses. The four subfamilies are: Alsinoideae (30 genera, 1040 species), Caryophylloideae (26 [20] genera, 1500 species), Paronychioideae (17 genera, 200 species), and Polycarpoideae (16 genera, 210 species). The most commonly cited classification (Bittrich 1993) includes three subfamilies, treating the Polycarpoideae as a tribe within the Paronychioideae. Preliminary evidence indicates that the Alsinoideae and the Caryophylloideae form a monophyletic group within the family separate from members of the other two subfamilies (Nepokroeff et al. 2002; Fior et al. 2006).

The balance of this paper will compare the two treatments of Caryophyllaceae of North America (Rabeler & Hartman 2005 and Robinson 1897) by subfamily and summarize the increases in both native and alien members. Our analyses take into account differences in taxonomic rank, although subspecies and varieties are combined under the collective term, infraspecific taxa.



TABLE 1. A comparison of the number of genera (g), species (sp), and infraspecific taxa (infra) by subfamily as found in the two taxonomic treatments of the Caryophyllaceae.

Subfamily	Robinson 1894, 1897	Rabaler & Hartman 2005
Alsinoideae	5 g/ 77 sp + 28 infra	16 g/ 137 sp + 32 infra
Caryophylloideae	8 g/ 68 sp + 19 infra	8 g/ 89 sp + 14 infra
Paronychioideae	7 g/ 24 sp + 1 infra*	6 g/ 32 sp + 4 infra
Polycarpoideae	6 g/ 22 sp + 5 infra	7 g/ 28 sp + 4 infra
*projected tally – see text		

At the subfamily level, most of the differences involve the Alsinoideae (Table 1). Changes within this subfamily (stipules absent; sepals not awned, free or only basally connate; petals usually present; fruits capsules) encompass most of the new generic alignments and new species, both native and introduced. Robinson followed a broad concept for *Arenaria* and *Stellaria*. The narrower concepts we employ recognized six genera (*Arenaria*, *Eremogone*, *Honckenya*, *Lepyrodiclis*, *Minuartia*, and *Wilhelmsia*) in the former genus and three (*Myosoton*, *Pseudostellaria*, and *Stellaria*) in the latter.

By contrast, the Caryophylloideae (stipules absent; sepals not awned, fused basally into a cup or tube; petals present, often conspicuous; fruits capsules) treatment deviated the least. The major differences are Robinson's segregation of *Lychnis* from *Silene* (Morton 2005b preferred a more inclusive circumscription) and the addition of 10 new native species of *Silene*.

The differences in the Paronychioideae (stipules present; sepals often awned, distinct or scarcely fused; petals absent; fruits utricles) treatments involve the addition of ten new taxa of *Paronychia* and the transfer of *Scleranthus* to the Alsinoideae.

Within the Polycarpoideae (stipules present; sepals rarely awned, distinct or scarcely fused; petals absent or often present; fruits capsules), major changes involve the addition of the genus *Polycarpaea*, two new alien species of *Spergula*, and five additional species of *Drymaria*.

The net change in the number of taxa between the two treatments is shown in Table 2. As noted above, the increase in the number of genera (26 to 37) mostly reflects differences in generic concepts. Change in the number of species (185 to 286) suggests that the number of species has increased by 50 percent; this is somewhat inflated since some of Robinson's infraspecific taxa are now treated as species (e.g., in *Cerastium*). The very similar numbers of infraspecific taxa (53 vs. 54) is somewhat deceiving. Besides elevation of some taxa to the species level, others are no longer recognized (e.g., the five varieties of *Silene douglasii* that Robinson recognized). On the other hand, 22 varieties and subspecies in the FNA treatment have been described since 1894. Given these caveats, the total taxa comparison (species + infraspecific taxa excluding autonyms), although increasing by about 40 percent since 1894, probably underestimates the actual change.

#### CHANGES INVOLVING NATIVE TAXA

Since the beginning of North American botany, most floristic attention has been on collecting and identifying our native flora. The distribution of new native species by genus is shown in Table 3. One native genus (*Geocarpon* in 1914) and 49 native species have been described since 1894. Not only are 63 percent of these species in the Alsinoideae, but 45 percent are within *Arenaria* s.l.

The majority of the new native species were first discovered in the western United States; not entirely unexpected given that, prior to 1890, much of the West was poorly known botanically. In descending order, California (12), the southwest United States (10), Texas (8), Alaska (4), and the Pacific Northwest (3) account for 37 of the 49 species. The remaining 12 initially were discovered in northeastern North America (5), southeastern United States (3), Russia (2) and the central United States (2).

#### CHANGES INVOLVING INTRODUCED TAXA

Efforts to document our alien (introduced or exotic) flora more precisely than "occurring as a weed here and there" (*Gypsophila muralis* L., Gleason and Cronquist 1991) have increased in recent decades. Rabaler has



TABLE 2. The number of genera, species, and infraspecific taxa (excluding automatically created taxa) recognized in each of the two treatments. These figures are followed by the percent increase, respectively.

	Robinson	Rabeler & Hartman	% increase
Genera	26	37	42
Species	191	286	50
Infraspecific	53	54	1
Total taxa	244	340	39

TABLE 3. The numbers of new native species for North America by subfamily and genus.

<b>Alsinoideae (31):</b> Arenaria (4), Cerastium (5), Eremogone (5), Geocarpon (1), Minuartia (11), Pseudostellaria (2), Stellaria (3)
<b>Caryophylloideae (10):</b> Silene (10)
<b>Paronychioideae (5):</b> Paronychia (5)
<b>Polycarpoideae (3):</b> Drymaria (2), Spergularia (1)

been involved in reporting new introductions of species and distribution records for Caryophyllaceae over the past 29 years (Rabeler 1980). Likewise, botanists at the Rocky Mountain Herbarium (see Hartman and Nelson 2008) have made a concerted effort to document invasives during more than 54 major inventories throughout the Rocky Mountains (over 840,000 new numbered collections since 1978, both native and introduced) These initiatives long preceded the recent piqued interest in exotics. Alien taxa are very important in the Caryophyllaceae. Of the 37 genera in the 2005 treatment, all members of 15 of those genera (41%) are introduced to North America; this includes six of the eight genera in Caryophylloideae.

The distribution of new introduced species by genus is shown in Table 4. Three genera (*Polycarphaea*, *Lepyrodiclis*, *Moenchia*) did not appear in Robinson (1897) despite *Moenchia erecta* (L.) G. Gaertn., B. Mey. & Scherb. having been collected near Baltimore and Philadelphia in the 1830s (Rabeler 1991). Thirty species, one-half of them members of the Alsinoideae, were first reported since 1897; seven of these were documented in North America subsequent to 1960.

Knowing when and where an introduction first arrived in North America is nearly impossible unless it was introduced intentionally. For example, *Petrorrhagia prolifera* (L.) P.W. Ball and Heywood was brought to North America around 1800 and appeared in John Bartram's garden in Philadelphia (Rabeler 1985). Of course, the actual documentation of the plant may be long after its introduction.

Where documented, the first collections of "new" introductions were chiefly from coastal states, especially port areas. They include the southeastern United States and Texas (8), California (6), the Pacific Northwest (6), and northeastern North America (4). Only three species appear to have been gathered first in an inland state or province (*Moehringia triphylla* (L.) Clairv. in Ohio, *Cerastium diffusum* Pers. in Missouri, and *Silene sibirica* (L.) Pers. in Saskatchewan).

Some recently discovered aliens, especially those first collected in the southeastern United States, have become widespread in eastern North America (e.g., *Stellaria pallida* (Dumort.) Crépin, *Cerastium pumilum* Curtis, and *C. brachypetalum* Pers. Of the aliens included in Robinson (1897), some have become widespread. *Gypsophila paniculata* L. noted as "doubtful in Manitoba" now is a noxious weed there as well as in California and Washington (Rice 1997 onwards). *Holosteum umbellatum* L., in Robinson's time known only around Philadelphia, Pennsylvania, is now documented from 41 states or provinces (see esp. Shinnors 1965).

The occurrence of two alien species has diminished sharply. *Agrostemma githago* L. and *Vaccaria hispanica* (Mill.) Rauschert were formerly very common in wheat fields. As agricultural practices advanced, seed purity increased and transport of propagules of these species declined. In both cases, the range maps in the FNA treatments (Thieret 2005; Thieret and Rabeler 2005) are probably best described as historical



TABLE 4. The numbers of new introduced species for North America by subfamily and genus.

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<b>Alsinoideae (15):</b> Cerastium (6), Lepyrodiclis (1), Moehringia (1), Moenchia (1), Sagina (2), Stellaria (4)
<b>Caryophylloideae (14):</b> Dianthus (2), Gypsophila (2), Petrorhagia (2), Saponaria (1), Silene (7)
<b>Paronychioideae (4?):</b> Paronychia (2), Herniaria (1), Scleranthus (1?)
<b>Polycarpoideae (6):</b> Drymaria (1), Polycarpaea (1), Spergula (2), Spergularia(2)

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maximal distributions. While very few recent collections were seen during the preparation of those treatments, *Agrostemma githago* remains on the noxious weeds lists of 13 states or provinces (Rice 1997 onwards).

#### WHAT MIGHT THE FUTURE HOLD?

We believe that there are additional native Caryophyllaceae yet to be described in North America. Nineteen of the 286 species in the FNA treatment were described since 1960. Two additional species have been described, both from California, since the 2005 treatment; *Silene salmonacea* T.W. Nelson, J.P. Nelson and S.A. Erwin (Nelson et al. 2006) and *Eremogone cliftonii* Rabeler and R.L. Hartman (Rabeler & Hartman 2008).

Likewise, the number of exotics are bound to increase. With seven species in the 2005 treatment first reported since 1960, it seems likely that as botanists take our dynamic alien flora more seriously, the tally will rise.

In addition to new discoveries and distributional records, additional study of the relationships of the taxa likely will change the treatment of the Caryophyllaceae. Many such questions are discussed in the FNA treatment (Rabeler & Hartman 2005) and could form the basis of interesting studies. As examples, do *Stellaria dicranoides* and *Stellaria fontinalis* really belong in other genera (Morton 2005a) and should *Silene* and/or *Minuartia* be treated as multiple genera as discussed by Morton (2005b) and Rabeler et al. (2005) respectively.

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